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Address by DR. HUGH L. DRYDEN, Director, National Advisory Committee for Aeronautics, at dedication of the Convair-Astronautics plant, San Diego, Calif., July 12, 1958

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By way of an introduction - you might call it the text of my remarks - I should like to read briefly from the thoughts of several others:

First, Senator Lyndon Johnson: - "Last fall the peoples of the free world became suddenly and apprehensively aware of the importance of space technology. When Russia launched its sputniks we knew we were in the space age, and we knew we had not entered it first."

Second, Damon Runyon: - "The world doesn't ask how you won; it asks if you won."

Third, Congressman John W. McCormack: - "The worlds of outer space are the greatest challenge to dynamic thought and deed that our pioneer spirit has ever received."

And, fourth, from the report of the Senate Space Committee: - "Space is presented to us, at this juncture, as a frontier. It is a dimension, not a force, a dimension enlarging the sweep and scope of all our established activities to the measurement of infinity - as the frontier of the American West enlarged the potential of the colonies to the limits of a continent. For any frontier, as Americans know from their national history, the imperative is exploration, not control. Only by exploration - by pioneering the unknown, by venturing the uncertain - can the promise of any frontier be realized. This must now be our imperative for the space frontier . . to 'marshal our resources and order our course' is a task of the greatest delicacy which must be accomplished under the most unrelenting urgency."

Last October, Russia's Sputnik I pre-empted the banner-line position on the front pages of our nation's press, but only briefly. Very soon, top news priority was recaptured by such matters as the world series and portents of the early phases of the football season. Without being facetious in the slightest, one may question whether our labeling the playoffs between the winning teams of our two major baseball leagues as the World Series is not all too typical of our easy assumption that here in the United States, our best is automatically the best in the world.

Over the years, we did in fact win positions of leadership in many fields, always peacefully and always for peaceful purposes. We pioneered in the tremendously important step of providing free educational opportunities through the high school grades for all our young people, and we made similar educational progress, beginning a century or so ago, by establishing state universities across the nation. The airplane was developed in the United States, and after a faltering start, we became and remained supreme in the air. In this latter case, the military services, the aircraft and engine industries, and the NACA worked effectively as partners under our democratic system which, if we only take the time to appreciate it, is so precious to us all. Possessed of seemingly inexhaustible quantities of raw materials, we became supreme in the techniques of mass production, manufacturing enormous quantities, both of plowshares and swords. Today, we can truthfully say we have manufactured vastly greater numbers of automobiles, telephones, bathtubs, television sets in monochrome and color, and automatic dishwashers than any other nation on the face of the earth.

Until very recently, we could also say that we had significantly larger numbers of airplanes, submarines and the other necessary items of the military arsenal. We knew, even though it may have seemed that some of our world neighbors were needlessly suspicious on this count, that our military might would never be employed except to protect the free peoples of the world.

Since World War II there has been a tremendously important change in world affairs. Our position of global leadership is being challenged in many areas. Some of these challenges - all of them coming from the Communist-dominated peoples - are of minor importance, such as the determined, successful effort of Soviet Russia to pile up the largest number of points in the last Olympics. The implications of some of the other challenges are extremely ominous.

This afternoon, I wish to discuss briefly some aspects of our current technological posture and in particular of our status in space technology and exploration. At the very start, I should like to emphasize the necessity of our planning on programs so that they will be adequate to our needs as a nation. The size and vigor of our space program must be firmly established and ratified by the Administration, the Congress, and finally, the American people. Our space program must make effective use of all our national resources.

Before further detailed discussion of the space program I wish to comment on certain general aspects of our technological situation. We must somehow encourage a much larger percentage of our bright youngsters than is the case today to become the scientists and the engineers that are required even now by the rapidly expanding technology of our day. One way to insure that our boys and girls spend longer hours studying mathematics and physics and the other necessary scientific disciplines will be to offer them greater returns in terms of prestige and, to state it very bluntly, money. I don't suggest that the artisans and all the other valued workers of our community be paid less for their work. I do suggest that we will have to provide substantially greater rewards than are presently available to those of our youth who have the latent talents and are willing to undergo the long and difficult schooling that will fit them for the technical tasks ahead.

We must insure that we use, with maximum effectiveness, our already large pool of scientific and technical manpower. Similarly, we must be efficient in employing such of our industrial organizations as are now well qualified in the performance of the work that needs to be done. We can no longer afford needless duplication of effort. There will be enough for everyone of us to do if we are to accomplish the paramount task of attaining and holding a position of world leadership in space technology.

Let us turn now to the space program specifically. In making the difficult decisions that will determine the character--and also the ultimate success--of our national space program, we cannot ignor the fact today, Soviet Russia is obviously working harder than we are to achieve pre-eminence in the conquest of space. Perhaps equally important, Soviet Russia has been very realistic in the establishment of the goals it wished to reach in missilery and in space technology. Once those goals were established, Soviet Russia has worked to reach them with amounts of energy and a singleness of purpose that have produced spectacular results in a remarkably short time.

We now know that with the end of World War II, the Russians undertook development of ballistic missiles capable first of intermediate range and then of intercontinental range. The Russian decisions to go ahead with ballistic missile development were made despite two factors: (1) the atomic and nuclear warheads then possible to construct were so heavy as to require enormously powerful motors, and (2) there remained extremely difficult problems of guidance that had to be solved, if reasonably accurate delivery of the warhead was to be attained.

The decision in the United States--in the presence of the same factors--was to concentrate a large part of the money we wished to spend for national defense on B-36 procurement instead of on development of long-range ballistic missiles. I don't believe I need to mention here what company built those B-36's. Nor do I need to remind you that for ten years, the great deterrent force represented by the range and load-carrying capability of this airplane played a major role in protecting the United States from attack.

I am not seeking today to "explain away" what, by benefit of hindsight, may appear to have been a doubtful decision. Most surely, we would have been farther along with the Atlas program if it had not been shelved in 1947, a casualty of cutbacks in the Defense budget. On the other hand, it was not until the nuclear breakthrough of 1952-53 that development of the long-range ballistic missile became really attractive, from the U. S. standpoint, and the ICBM program was resumed, this time on a crash basis.

For the past decade, we needed long range bombers for our nation's protection, and we had them--the piston-engine B-36. Within the past two years or so, both we and Russia have produced long range turbojet bombers. I personally believe that we will need a manned bomber force for a long time to come.

In addition, it is apparent that we also need the deterrent capabilities of the ICBM. Thanks in no small part to the Convair company-financed ballistic missile development program that was continued through the years of no government support, the Atlas will achieve initial operational capability by the end of next year.

I have discussed these matters in such detail because, as a matter of fact, the extent of our penetration into space in the next few years will depend in large measure upon how effectively we use knowledge already in hand, and upon how hard we work to reach the distant goals we have set for our instrumented and man-carrying space craft. Except for the great progress made in the past 55 years toward solution of the problems of flight--as they affect the airplane and the ballistic missile--we would be but little closer to the exploration of space than the dreamers of early times.

The basic components of the first successful airplane in 1903, were the structure, the powerplant, and the control system. The same components are with us today, in both our Mach 3 airplanes and our ballistic missiles. They will be the basic components in tomorrow's space craft.

For some time to come, no matter how many thousands of miles an hour it attains or how far into space it travels, any flight vehicle has to start from earth and accelerate from zero speed. It has to span the transonic and supersonic ranges. Its early flight is within the atmosphere. Similarly, on its return to earth from flight into space, any vehicle has to decelerate on re-entering the atmosphere. It has to slow down further, to make a safe landing at low speed. In the more distant future we will have space vehicles operating from stations in orbit for which these problems disappear and quite new problems become dominant.

Even today, the requirements of flight into space impose new and very difficult demands upon our technology, but what is mainly required is raising to new, very high levels, our competence in propulsion, structures, and guidance and control. It may be over-simplification, but it is hardly over-statement to say that what we must do compares to the technological advances that made possible the past transitions from wood-and-fabric to all-metal airplanes, from piston engines to turbojets, from subsonic to supersonic speeds, and from lowlevel to high-altitude, pressurized flight. Each of these remarkable gains in flight performance became possible because of the contributions by many men, working in many scientific and engineering disciplines.

As I speak to you today, a new space agency is in process of birth, built around the present National Advisory Committee for Aeronautics.

Since the end of World War II, the NACA has been engaged increasingly in research applicable to the problems of space flight, and has designed and constructed the special aerodynamic, structural and propulsion facilities required for this work. On Monday, at the inspection of the NACA's Ames Aeronautical Laboratory at Moffett Field, Calif., there will be discussions about some of these facilities--high velocity guns and ballistic ranges, atmospheric entry simulators, arc wind tunnels and other facilities capable of producing very high temperatures, rocket facilities for research on high energy fuels, etc. At the present time, roughly 50 per cent of the NACA's basic and applied research is focused on these problems, directly or indirectly applicable to space flight.

In 1952, the NACA formally initiated studies of, and I quote, "the problems associated with manned and unmanned flight at altitudes from 50 miles up and at speeds from Mach number 10 to the velocity of escape from the earth's gravity."

One result of this work, begun six years ago, was the X-15 program in which the Air Force, Navy and NACA are co-operating. North American is building the airframe and Reaction Motors the rocket engine.

The X-15 is a research tool especially designed for use in studying certain problems that will have to be solved to permit manned flight into nearby space with good expectations of bringing the pilot back alive. These problems include the control of the attitude of the vehicle in space in the absence of aerodynamic forces, the safe return from space to the atmosphere without destructive heating, and the effect of weightlessness on the pilots for periods measured in minutes rather than seconds. Under some flight conditions, the surfaces of the X-15 will glow at red heat.

I should like to emphasize what I said earlier; space flight requirements will impose new and very difficult demands upon our technology. I should like to emphasize also how greatly our current planning of a vigorous, intelligent national space program will be aided by the work already done by scientific and industrial organizations. I mentioned 1952 as the year when NACA formally began its space flight studies. That, I hardly need remind you, was the year Convair began its first work on space flight. I should add that this $40 million space technology facility we are dedicating today--half the cost of which has been financed by Convair and half by the Air Force--was undertaken in 1956, long before Sputnik No. 1. We are, of course, in only the earliest stages of our work on space flight problems, but already a very substantial effort has been exerted, with results of great and positive value.

For example, the re-entry problem was one of the most difficult facing the designers of the ICBM. The blunt-nose concept was formulated in 1952 by H. Julian Allen at the NACA's Ames Laboratory. Much work was necessary, including the obtaining of experimental proof in actual flight of the concept's validity. Engineers had to achieve the refinements that would enable use of the concept in the design of a specific warhead for a specific ballistic missile. During the past six years, this difficult, time-consuming work has been brought to the point where every American ballistic missile of either intermediate or intercontinental range, incorporates the blunt-nose concept.

The same principles will have to be applied to make possible safe return to Earth of the man-carrying satellites and space vehicles of tomorrow. There will, however, be the further complication, that man-carrying craft cannot be decelerated so rapidly as an ICBM warhead; the pilot couldn't stand the resulting "G" forces.

We see the need for new types of engines - nuclear-powered rockets, ion jets, and perhaps others. Nuclear energy also will be used for internal power sources of the far-ranging space craft. To develop these to a state of usefulness will require large effort, and years to accomplish. There is, however, no need for us to wait for the new engines. Our "conventional" rocket engines can be enlarged very substantially, and a rocket engine with a million pounds of thrust can be most quickly attained by use of a cluster of rockets, each producing several hundred thousand pounds. Nevertheless, development of the larger engine should be undertaken promptly.

To sum up, there are many problems common to aeronautics and astronautics, particularly those arising within the atmosphere on take-off and during re-entry and recovery. There will be many other problems, some new and some old, such as guidance, communication, and power sources.

No existing agency has within it all the skills and resources needed. Today, there are very few experienced astronautical engineers. Fortunately, there are scientists and engineers experienced in rocketry, aerodynamics, guidance, communications, structures, and human factors. These are men who will have to solve our space flight problems.

NACA was selected by the President - and legislation passed by both Houses of the Congress concurred - as a good foundation on which to build the new civilian space agency because of its staff, experienced in many of the requisite fields, and of its 350-million-dollar facilities supporting work in aerodynamics, structures, and propulsion. It would be possible for the new National Aeronautics and Space Administration, as soon as it has been established and the necessary financing appropriated, to build new research centers for study of problems in other areas. Such a procedure would be very costly. Trained people to accomplish the work would have to be recruited and organized into a useful staff. Almost certainly, they would have to come from scientific and engineering organizations already engaged in work of importance to the national interest. Even more critical would be the passage of months and years before the new laboratories could begin producing information vital to the space programs.

A far wiser course, I believe, will be for NASA to make effective use, on a contract basis, of teams of experts and laboratory facilities already in being. To be sure, some new research facilities will be needed by NASA at NACA's existing laboratories and at new laboratories. But most of the expanded activity of NASA will be accomplished through a greatly expanded research program to obtain assistance from groups with special competence in specific areas. Thus, special talents, experienced staffs, and facilities of existing organizations can be pooled for the accelerated effort that is required.

NASA will have to develop new space vehicles. It would be possible for NASA to build the organization and the facilities for such space vehicle design and construction. But again, such action would be very costly and much additional time would be required. It is preferable that design and construction of these space vehicles be performed, on a contract basis, at existing facilities.

I am sure that our aircraft and missile industry is more than casually interested in who may be asked to build the space craft and rocket motors for the civilian programs of space exploration and exploitation. One obvious answer is that the organizations best qualified will get the jobs. I would make the further observation that when changing military requirements called for production of ballistic and other missiles to supplement the capabilities of the bomber, the aircraft industry demonstrated that its design and production teams were singularly qualified to develop and build missiles. So long as the technical and production competence of the aircraft and missile industry can keep up with the exploding needs of the national space program, the same reasons that discourage construction of new laboratories and scientific teams to perform work that can be done by in-being research organizations will apply to space craft development and construction.

The space programs we are proposing for NASA accomplishment are three-fold in scope. There must be adequate research effort on space technology problems. There must be development and use of unmanned vehicles capable of carrying the desired scientific data gathering apparatus. Finally, there must be the development and orderly use of man-carrying vehicles in the exploration of our solar system. The three parts of our program must be skillfully integrated and coordinated. Just as rapdily as research can provide the necessary information, we should use it in developing--and launching--both automated and manned vehicles with greater performance and sophistication.

I should like to quote Jimmie Doolittle, Chairman of the NACA, before the Special Committee on Space and Astronautics of the Senate several weeks ago:-

"Today, we are at the very edge of one of the great frontiers of history. The frontiersmen who explore the vast reaches of this unknown region will be the space scientists. They will undertake their explorations, because they are compelled by the drive that motivates every true scientist to seek new knowledge, valuing it for itself. For us to attempt to gauge each of these adventures into space on the basis of the value of its expected immediate results would, I fear, defeat the very purposes of the essential master plan for the peaceful conquest of space. Around the world there are signs that, even in

Russia, the peoples of this earth are beginning to realize that the new weaponry man has invented cannot be fully used without upsetting our civilization."

The launching of the first satellites focused attention on another form of international competition which can be pursued without leading to a world catastrophe and which is effective in influencing the attitudes of the peoples of the world. This is the competition in science and technology for peaceful purposes.

In the climate of today, we must be strong in these areas and a world leader. Such leadership in space technology and exploration will lay the foundation for leadership in peace, and if peace should fail us, would be an indispensible military asset.

I close by speaking for a moment as a private citizen. I hope that what I say will express the inner thoughts of all of us who are gathered today for this dedication of the new Convair-Astronautics plant. The General Dynamics Corporation management in 1956 had the courage and the foresight to invest $20,000,000 of the money of the company stockholders in building this splendid new facility so that the pioneering work in missilery and space technology can be carried forward more effectively and more rapidly. The Air Force realized the value of this bold action, and matched company funds for machine tools and other essential equipment. While the facility was taking form, the Astronautics Division was increasing its teams of highly trained personnel for the added work to be done.

Now, in a time of urgency, we can expect valuable performance from the Astronautics team in its new plant.

May we wish devoutly that the products from this great new plant can in the years ahead be assigned to peaceful pursuits, for the benefit of all mankind.

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